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Address:-Ashok Yakkaldevi 258/34, Raviwar Peth, Solapur - 413 005 Maharashtra, India
Cell : 9595 359 435, Ph No: 02172372010 Email: ayisrj@yahoo.in Website: www.isrj.net

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A Study Of Body Mass Index (bmi) Among School Children (6-18 Years Of Age) From Rural Areas

Kalange D. N. And Patil V. B.
Assistant Professor (Statistics) A.C.S. College, Palus
Director of Physical Education A.C.S. College, Palus

Abstract:A Cross-sectional study was carried out among randomly selected 360 school children, aged 6-18 years in Palus. The children were divided into four different age groups to study age trend. The descriptive statistics were computed from the data collected. The multiple regressions were carried out to predict weight from age and height. The children classified according to Body Mass index (BMI) into different categories. According to the reference chart of World Health Organization, significant number of children was found to be underweight. The significant positive correlations among age, height and weight of the children were observed. The results observed in the present study resonate with studies conducted by various researchers

Keywords: Body Mass Index; Obesity, school children; nutritional status; Correlation; Multiple regression.

INTRODUCTION

Anthropometry is the one of the most basic tools for assessing nutritional status, whether over-nutrition or under-nutrition (Zugao Mei et al, 2002). A variety of methods are available to measure body fatness and body thinness. Height- and weight-based measurements are the most commonly and practical tools used for assessing nutritional status because of their simplicity and low cost. Anthropometric parameters are frequently used by physicians and health workers as a valuable instrument to define nutritional status, and assess the growth and development of children. Decisions for policy-making and planning in public health nutrition must be based on accurate anthropometric information on the population for which it is intended to be used. Body mass index (BMI) is positively and independently associated with morbidity and mortality from hypertension, cardiovascular disease, type II diabetes mellitus, and other chronic diseases (Collin Bell et al). In Caucasian populations, a strong association has been depicted between BMI and mortality. A similar association has also been demonstrated among Asian populations (Deurenberg et al, 2002). Since somatic growth is an indicator of a child's health and nutrition, updated population-specific reference growth charts are needed. This need has been further reinforced and recommended, based on the observation, that over the past few decades' children worldwide have become taller and heavier. The aim of the present study is to assess nutritional status of school children in Palus Tahsil using BMI relative to the international health reference chart of World Health Organization (WHO).

2. REVIEW OF LITERATURE

A number of studies have been conducted in the literature on the use of Body Mass Index (BMI) for assessing nutritional status and to study obesity. We have taken survey of the few selected and concerned research articles in the following: Mushtaq et al (2012) have conducted study among Pakistani school children with the objective of exploring nutritional parameters and indices of nutritional status with reference to international growth references. They have observed that Pakistani school-aged children significantly differed from WHO and USCDC references. Overweight and obesity were significantly higher while underweight and thinness/wasting were significantly lower relative to the WHO references. Their study recommends development of new growth chart for Pakistani children based on nationally representative sample.

The study of relationship between nutritional status and body mass index for age with learning achievement of rural children in kumi district (east of Uganda) was conducted by Acham et al (2008). They observed that nutritional status as measured by height-for-age (HAZ), weight-for-age (WAZ) and BMI have an association with learning which is positive for Mathematics and English but negative with Life Skills and Verbal Comprehension among children in Kumi district. Lise Dubois and Menon Girad (2007) have conducted study to investigate accuracy of maternal reports of Pre-schooler's weights and heights as estimates of BMI values. It was observed that mothers overestimate their children's weight more than their heights resulting in an overestimation of overweight children. They emphasize the importance of collecting measured data in childhood studies of overweight and obesity.

Boeke et al (2013) have conducted study among multiethnic school-aged children to determine correlations among adiposity measurements. They found that, among

school-aged children, BMI, sum of skinfolds and other adiposity measures were strongly correlated with DXA (Dual X-ray absorptiometry) fat mass. They have also concluded that BMI and skin folds are adequate for study, although these measurements have limitations. Abdulwahab Naser Al-Isa et al (2010) have conducted study to identify factors associated with overweight and obesity among Kuwaiti elementary male school children aged 6-10 years. They observed that fourteen factors that were significantly associated with overweight and obesity. They concluded that health education programs for families should be implemented to control overweight and obesity in Kuwaiti children. Zuguo Mei et al (2002) have conducted validation study of body mass index compared with other body composition screening indices for the assessment of body fatness in children and adolescents. The objective of the study was to validate the performance of age-and sex-specific BMI compared with Rohrer Index (RI) and weight-for-height in screening for both underweight and overweight in children aged 2-19 years. They observed that BMI for age was significantly better than weight-for height and Rohrer Index (RI) in detecting overweight when average skinfold thicknesses were used as standards, but no differences were found in detecting underweight.

Crosnoe and Muller (2004) have examined the educational experiences of American adolescents at risk of obesity by conducting study on BMI and academic achievement in school context. Their study revealed that the negative longitudinal association between risk of obesity and achievement was stronger in schools. They observed that adolescents with risk of obesity have lower academic performance. An anthropometric survey of Delhi school children aged 6-14 years were conducted by Meenu Dhingra et al (2010) with the objective of assessing nutritional status. They compared height, weight and BMI with WHO new growth standards 2006. Based on the study, they concluded that the overweight condition of both boys and girls of Indian schools. They have suggested that nutritional intervention and physical activity programme to prevent any further complications. Lisa Bailey-Davis et al (2007) have conducted study to examine 3-years trends and spatial clustering in the prevalence of obesity among elementary-aged children in Pennsylvania. They have observed that the mean prevalence of obesity remained stable over 3-year at approximately 16.6 % of elementary-aged children. School based surveillance elucidates the desperate risk of obesity for younger students living in most rural areas. They also suggested that preventive interventions are needed to reach the most rural children with an emphasis on families when parents are single, are unemployed, have a lower income, and low educational attainment. The purpose of the present study is to conduct anthropometric survey of school children aged 6-18 years and the comparison with international health standards.

3. STUDY AREA

Palus is tehsil place in the Sangli district. It has an industrial area and a wine park. It is also famous for Grapes. Palus MIDC is the biggest asset for Palus, which holds major component manufacturing and foundry process. Historical factory of Kirloskar brothers Ltd. is near to Palus. Palus tehsil is near to river Krishna and this tehsil is one of the fertile soils in Sangli district. Palus is also known for grape, sugarcane producing land. Here is famous School and Jr. College named by Laxmanrao Kirloskar Vidyamandir and Jr. College, which is located at West of Palus. Also, Bharti Vidyapeeth's school is located at north of Palus.

In recent years, Palus has transformed into semi-urban locality, showing remarkable growth in population. As per published data of census 2001, the total population of Palus was 18296, of which 9591 and 8705 were males and females respectively. The sex ratio was 908 females per 1000 males. In Palus, there are three different schools offering high school education, two junior colleges, and one senior college offering traditional university courses along with professional courses like B.C.S., B.C.A., B.B.A. etc. and one polytechnic college catering to the needs of technical education. In all schools and junior colleges in Palus, the total enrollment of students is 2568. The literacy rate of Sangli district was 82.75% (Census of India-2001)

Palus has become semi-urban locality. With urbanization and economic development, there has been a major shift in their Parent's occupation, improvement in socioeconomic status, and lifestyle. The staple food of the Population in Palus is bread of Jawar or Chapattis of Wheat, rice and leafy vegetables. Most of them take sweets, oily foods and milk products when compared with the mainland Indian populations. Most of them also take non-vegetarian food atleast once in a week.

4. SUBJECTS AND METHODS

A cross-sectional study was carried out among 360 students of school and junior college students of Palus, aged 6 to 18 years, of these male and female were 180 each. The subjects were divided into six different age groups with three years interval each to study the age trend of height, weight and BMI. Field survey was carried out in schools and colleges to collect data. The subjects were selected from Palus in Sangli district of Maharashtra state in Southern India. Both the purpose of the study and techniques to be used were explained to subjects in classes. Subjects gave consent for study and volunteered happily. All measurements were performed in accordance with relevant guidelines and regulations. The research described was compliant with basic ethical standards.

Nutritional transition characterized by growing intake of fat-rich diet, processed and fast food culture was observed among the children in younger age groups. Population in Palus has undergone a lot of changes in the past decade in every sphere of their lives, in terms of occupation, economy, traditional practices, and overall lifestyle. The socioeconomic development has created changes in dietary intake, food consumption patterns, and physical activity levels over the years. The transition has brought about nutritional transition, changes in their body composition, physiological functions, and also health among others. It has also contributed to the problem of increasing overweight/obesity and cardiovascular diseases among population. In the present study, an attempt has been made to find the association between body mass index and age and

also to multiple regression of body weight on age and height among school and college students of Palus.

4.1. Assessment and Classifications of BMI

For the assessment of BMI, height, and weight measurements were taken using standard protocols. Stature was measured by anthropometer to nearest 0.1 cm and weight was measured using portable spring weighing machine with least count of 0.5 kg, in light clothing and without shoes. Statistical analyses of the data collected were carried out using MS-EXCEL- 2007 spreadsheet Package. Correlation analyses were done to determine the association between weight, height and age. Multiple regressions were performed to explain the impact of predictor variables age and height on weight. The value of BMI was calculated and summarized age group wise, and in order to assess BMI-based nutritional status, recommended cutoff points for Asians were used. Body mass index (BMI) is calculated by using the formula:

$$BMI = \frac{Weight\ (\ in\ kg)}{height^2\ (m^2)}$$

The World Health Organization (WHO) suggested BMI categories are as follows:

BMI	Category
< 18.5 kg/m^2	underweight
18.5 – 23 kg/m^2	increasing but acceptable risk
23 – 27.5 kg/m^2	increased risk
=27.5 kg/m^2	high risk

It should be noted that, in Asian subjects, the risk associated with diabetes and cardiovascular diseases occurs at lower levels of BMI when compared with the white population. This is attributed to body fat distribution.

4.2 Summary of Data Analyses

The collected data is analyzed by using MS-EXCEL 2007 spreadsheet program which has in-built statistical functions. The built-in statistical functions are used to compute averages, standard deviations and correlations between the variables under study.

Table 1: Basic data and BMI of the Boys in different age groups

Age Group (months)	Age group (months)		Stature (cm)		Body weight (kg)		Body mass index (kg/m^2)	
	mean	S.D.	mean	S.D.	mean	S.D.	mean	S.D.
72-108	85.84	± 9.94	114.40	± 4.84	24.81	±3.56	18.90	±1.99
108-144	123.22	±10.94	134.55	± 5.82	34.26	±5.74	19.93	±3.09
144-180	158.21	±10.27	150.49	± 7.11	43.42	±4.28	19.23	±2.09
180-216	196.73	±10.28	167.21	± 6.32	52.17	±5.16	18.67	±1.77

Table 2: Basic data and BMI of the Girls in different age groups

Age Group (months)	Age group (months)		Stature (cm)		Body weight (kg)		Body mass index kg/m^2)	
	mean	S.D.	mean	S.D.	mean	S.D.	mean	S.D.
72-108	86.44	± 9.94	118.40	±10.45	24.50	±4.18	17.59	±2.79
108-144	123.54	±9.83	137.97	±5.74	35.78	±3.52	18.84	±2.02
144-180	160.32	±11.01	152.03	±5.09	43.33	±5.32	18.73	±1.92
180-216	199.15	±11.63	160.01	±4.92	49.03	±3.88	19.22	±2.15

5. RESULTS

Basic data and BMI of male and female students of Palus in four different age groups are displayed in Table 1 and 2 respectively. The mean values for height were found to be 114.40, 134.55, 150.49 and 167.21 with standard deviation 4.84, 5.82, 7.11 and 6.32 for four age groups ranging from 6 to 18 years respectively. The differences in mean height, for both boys and girls, were statistically significant for all four age groups whereas among the rest of the groups, the differences were statistically non significant. Body weight increased with age for both boys and girls.

Table 1 and 2 also shows BMI in different age groups. Maximum value for mean BMI was 19.22 Kg/m2, found among 15-18 years age group. BMI was found to be lowest among 6-9 years age group and inclined thereafter. The differences in mean BMI was statistically significant between all the age groups except for 9-12 years and 12-15 years age groups. The mean values of all the age groups for BMI of boys and girls were found to be 19.18 kg/m2 and 18.60 kg/m2 respectively.

Table 3: Age and Sex-wise distribution of underweight subjects according to BMI values

Age group (Months)	Distribution of subjects in underweight category (N = 90)			
	N1	Percentage % (Boys)	N2	Percentage % (Girls)
72-108	21	23.33	36	40
108-144	27	30	21	23.33
144-180	21	23.33	20	22.22
180-216	22	24.44	12	13.33

Table 4: Correlation matrix between age, height and Weight of Boys

Variable	Boys			Variable	Girls		
	Age	Height	Weight		Age	Height	Weight
Age	1.00	0.94	0.84	Age	1.00	0.91	0.67
Height	0.94	1.00	0.82	Height	0.91	1.00	0.68
Weight	0.84	0.82	1.00	Weight	0.67	0.68	1.00

Table 5: Multiple Regressions for Boy's and Girl's Weight

Weight for Boys/Girls	Regression Equation	R^2
Boy's Weight	1.01+ 0.24*Age + 0.02*Height	0.89
Girl's Weight	0.80+0.19*Age + 0.05*Height	0.84

Table 4 shows correlation matrix for Male and Female students respectively. It indicates that there is strong correlation among the variables: Age, weight and height for both Boys and Girls.

The weight of an individual depends on his/her height and Age. Table 5 shows multiple regression of weight

on Age and height determined from the data, along with value of multiple coefficient of determination. Higher values of R2 represent the proportion of explained variations captured by the Regression equation

6. DISCUSSION

Increasing secular trend in the mean stature was evident from the oldest to the youngest age- groups. Improvement in socioeconomic conditions, and better nutrition among the younger subjects could be the reason. Multiple and Partial Correlation analyses between BMI and age showed significant positive correlations between them. In the present study, multiple regression equations of Weight for both the sexes were determined as given in table 5 based on predictor variables age and height. It was observed that both boys and girls have significant number of subjects which are underweight. The 30 % of Girls in the age 9-12 years and 40 % of males in the age-group 6-8 years were found to be underweight. The percentage of underweight children is comparatively high among school children in Palus.

7. CONCLUSION

The present study demonstrated that school children in Palus suffer from the underweight problem. Most of the school children in the study area come from neighboring villages, so it can be concluded that school children in rural areas are suffering from low nutritional status. Although, magnitude of correlations differed, positive and significant correlations among age, height and weight were found. It can be suggested that properly designed diet and training programme should be designed and implemented to tackle the problem of underweight among school children in rural areas.

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